Keating

Account of the Jeffersonite a new mineral discovered at the Franklin Iron works near Sparta in New Jersey by Lardner Vanuxem and William H. Keating — described and analysed by W & K — Read June 4th 1822

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About Six miles to the north East of the town of Sparta in Sussex County, New Jersey are to be seen the remains of the old Furnace of Franklin — This furnace situated on one of the most beautiful and eligible spots for the working of Iron offers a striking example of the failures which attend all works which are not conducted with a sufficient degree of attention to Scientific acquirements — Placed in the centre of an extensive forest, with an abundant supply of water, surrounded by numerous and unexhausted beds of ore, at a convenient distance from two good markets the Franklin works must have appeared to their first owners calculated to become of the highest importance, and such most undoubtedly would have been the results but for one difficulty which intervened, arrested the operations and after many fruitless attempts caused the total abandonment of the works, This difficulty was it is true of vital importance — It arose from ignorance as to the nature of the ore intended to be worked and of the Minerals which accompany it — Having long attempted to work by the common process an ore which was of a distinct nature and which consequently required a distinct mode of treatment, they at last threw up in disgust an undertaking which very little science would have made highly productive — To the late Dr Bruce we are indebted for

the first light thrown upon this interesting section of our country and to him the honour of the discovery of the Red Zinc ore is due — This was undoubtedly the first step toward the advancement of that section of the County — The next and a more important one was the determination of the real nature of the substance which had hitherto been Considered as a Common iron ore and which is now known under the name of Franklinite as a Combination of Iron, Zinc and Manganese — This discovery was made in the Laboratory of the Royal School of Mines in Paris in the Spring of 1819 and has been published by Professor Berthier in the 4th vol. of the Annals des Mines. 187

Having in the month of August last visited this spot with my friend Lardner Vanuxem Esquire of Columbia College (S.C.) our attention was directed with peculiar pleasure to a bed of ore which offered a number of new and interesting varieties of minerals and which we think bids fair to become as celebrated in mineralogy as the localities of Uto or Arendal —

It is not my object at present to enter into an enumeration of the minerals which occur there; this I shall defer untill I am enabled to furnish the Academy with a mineralogical and geological description of that ~~section~~ vicinity an object which Mr. Vanuxem and I have long had in contemplation and which we shall probably soon accomplish, unless some abler observer shall have before that time undertaken the task. I shall merely state that the minerals which we collected

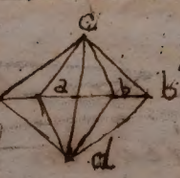
include besides the oxidule of Iron, Franklinite crystalised in regular octahedrons with truncated edges, Garnets of various kinds and among others and among others a black emarginated dodecahedral garnet analagous to the Melanite of Monte Somma, Chondrodite, the same variety as exists at Sparta and also a new variety of the same substance, besides many other interesting minerals —

The present Communication is intended to make known a mineral which an attentive examination made by Mr. Vanuxem and myself has induced us to consider as a new species — Our observations upon this mineral made separately and at a distance have led us to the same conclusion and the analysis which I undertook at his request has fully confirmed the Conclusions drawn from its mineralogical Characters — The following description includes besides my observations those with which Mr. Vanuxem has favoured me. For the results of the chemical analysis I stand alone answerable.

This mineral has hitherto been found in lamellar masses the largest of which does not exceed a pidgeon's egg imbedded in Franklinite and garnet —

It presents three distinct cleavages two of which are considerably easier than the third — These cleavages lead us for a primitive form to rhomboidal prism with a base slightly inclined The angles of the prism are 106.° and 74.° those of the inclination of the base are 94.° 45′ and 85.° 15′ There is another face which makes with the vertical face of the prism angles of 110.° and 70.° I have likewise seen in one instance cleavages parallel to a rhomboidal prism of 116.° and 64.° This prism I believe to be that which would result

Omit the words in the parentheses



from the first rhomboidal prism if the shorter diagonal of the prism ab were doubled while the longer cd remained unchanged.) I have also obtained cleavages under an angle of about 99°.45 and 80°.15'. I have not been able to trace the connection between these and the former, but I am inclined to think that they result from the combination of the two prisms just mentioned. I had hoped as some of the cleavages have a tolerable degree of lustre to have been enabled to determine the angles by the reflecting goniometer but all my attempts to that effect have proved unsuccessful I have not been able to obtain a reflection from any one face.

The Hardness of this mineral is intermediate between that of Fluor Spar and Apatite. It is very readily scratched by Gadolinite (Malacolite).

Its Specific Gravity varies from 3.51. to 3.55. I have in one instance obtained it as high as 3.64 but I suspect the original to have been mixed with Franklinite

~~It Colour is a dark olive green pale~~

It is slightly translucent upon the edges.

Its lustre is slight but semimetallic upon the faces of Cleavage; in the transverse fracture it is resinous.

The fracture is lamellar when in the direction of cleavage otherwise it is uneven.

When scratched with a Knife, the streak is greyish.

The Colour of the powder is a light green.

Before the Blowpipe it melts readily into a dark coloured globule.

It displays no electric signs, either naturally or by heat or friction —

It is not magnetic, either in the Common way, or by the ingenious method of double magnetism which we owe to Abbé Haüy

The Acids do not act upon it when Cold — When digested a long time with boiling nitro muriatic acid about 10/100 is dissolved — The residue is of a lighter Colour —

Its chemical Composition was ascertained by two analyses and the results of which were strikingly similar, as follows. +

Silex	0.560	containing Oxygen 29.14700	29
Lime	0.157	4.24159	4
Protoxide of manganese	0.135	2.95790	3
Peroxide of Iron	0.100	3.06600	3
Oxid of Zinc	0.010		
Alumine	0.020.		
Loss by Calcination	0.010		
	0.986		
loss			
	1.000		

By assuming the mineralogical formula $4CS^3 + 3MgS^3 + 2FeS^3$ which is very nearly that indicated by the results of the Analysis, we have for the Chemical formula

$$4\ddot{C}a\ddot{S}i^2 + 3\ddot{M}n\ddot{S}i^2 + 2\ddot{F}e\ddot{S}i^3$$ which gives us

Silex	20	20 atoms	Containing 60 atoms Oxygen
Lime	4		8
Protoxide of Manganese	3		6
Peroxide of Iron	2		6

+ Notes (vide next page)

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which proportions are so near those of the results of the analysis that we may adopt them without hesitation From this formula we obtain the true Composition of this mineral to be

4 at:	Trisilicias Calcicus	7619.60
3 at:	Trisilicias Manganosus	6313.23
2 at.	Trisilicias Ferricus	5535.38
1 atom new mineral =		19468.21

& else

20	Silex	11928.40
4	Lime	2848.24
3	Protoxide of manganese	2734.71
2	Peroxide of Iron	1956.82
		19468.21

Which reduced to 1000 parts gives

Silex	0.6125	cont'g Oxygen	3.0808750	30
Lime	0.1463		.4109567	4
Protoxide of manganese	0.1404		.3080376	3
Peroxide of Iron	0.1005		.3081330	3
	.999			

+ Note The mode of analysis was as follows - Having by preliminary experiments ascertained that this mineral was chiefly composed of Silex, Lime, Oxid of manganese and Oxid of Iron, and suspecting the presence of Alumine, magnesia and Oxid of Zinc from its ganzue the Franklinite, garnets &c Treated as follows - The finely pulverized mineral was fused in a Silver Crucible with three parts of caustic potash and kept

in fusion during half an hour; The fusion was readily obtained, the mineral communicated to the mass a reddish Colour with a greenish tinge on the edges. Having deluted the mass with water and saturated with muriatic acid, a Complete solution ensued By a careful evaporation to dryness the silex became insoluble in water slightly acidulated while all the other ingredients were dissolved. By the addition of a solution of saturated Hydrosulfate of potash the lime and magnesia (if any) were separated from the other substances which were precipitated. (Care had been taken to ascertain that the Hydrosulfate used precipitated neither of these earths). Oxalate of Potash was then added to precipitate the lime after which no precipitate resulting from the addition of Carbonate of Soda, proved it was evident that this Solution Contained neither magnesia nor any other substance except the alkalies added. The precipitate by the Hydrosulfate, which consisted of the Oxides of Iron, Manganese, & Zinc, with alumina was then calcined and weighed after which it was redissolved in Nitromuriatic acid. (The alumina being in very small quantity was also redissolved) A Saturated Carbonate of Soda was then added without excess precipitated the oxide of Iron leaving those of Manganese & Zinc. On examining the Iron it was found to have carried down with it the Alumina which was readily separated. The Oxyds of Manganese & Zinc were then

precipitated by a Subcarbonate of Soda and separated by means of ammonia according to the accurate method recommended by M. Berzelius and described by M. Berthier in the Annales des Mines — The loss by Calcination was ascertained by heating to white heat in a platina Crucible during a quarter of an hour — The colour of the mineral was slightly altered — it became of a brown tint and lost one per cent —
The powder was not magnetic either before or after Calcination —
(End of the note) —

This Mineral will therefore present in the language of M. Berzelius $4\dot{C}a\ddot{S}i + 3\dot{M}g\ddot{S}i + 2\dot{F}e\ddot{S}i$ for its mineralogical, and $4\dot{C}a\ddot{S}i + 3\dot{M}n\ddot{S}i + 2\dot{F}e\ddot{S}i$ for its chemical formula — new and appropriate

According to Professor Mohs new and elegant mode of classifying and describing minerals, this would form a new species in his Genus Augite Spar, and come in immediately after the Pyramidal & prismatic Augite spar (Pyroxene Haüy) On account of its many cleavages I would propose to give it as a Specific name, the epithet of Polystome — It would therefore be thus designated —

Class I
Order Spar
Genus Augite Spar
Species Polystome + Augite Spar —
Prismatic — Unknown — Cleavage $P + \infty = 106°$
$H = 4.5$ $G = 3.51 — 3.61$

+ from πολυς many and στομα mouth ⊛ note (see next page)

But untill Mr. Mohs' System be more generally known and approved of, it may be proper to give this mineral a name unconnected with his arrangement. Accordingly Mr. Vanuxem has proposed to dedicate this mineral to Mr. Jefferson; I have readily assented to this proposal and we now offer this mineral to the public under the name of the Jeffersonite.

This mineral has hitherto been found in too small a quantity to offer any utility in the arts. Should it however be found in sufficient abundance, it would become valuable as a flux for the Iron works in the vicinity. The absence of magnesia and the abundance of manganese seem to make it very valuable for this object.

Remarks

The Jeffersonite presents some points of resemblance with the Pyroxene of Haüy but still it can be well distinguished from it. Its cleavages are essentially different.

⊕. note. In order to make this species enter fully into the Genus augite Spar, it will be necessary to extend the limits of the Specific Gravity of this genus; from 2.7 and instead of from 2.7 to 3.5 make them from 2.7 to 3.6 an alteration which I think Mr. Mohs can by no means object to. Should the cleavages be as I am inclined to consider them, this species would be described as hemiprismatic instead of Prismatic but this is an alteration which it will always be time enough to make. (Vide Mohs' Characters of minerals. Dresden and Edinburgh 1820.)

form than of the Pyroxene but appear to approach some of the faces of Crystals of substances which have been united to this Species - for instance the angles in the Diopside (Mussite and Alalite), Fassaite, and in the Pyroxene analogique come very near some of the angles of cleavage obtained in the Jeffersonite I at first indulged the idea that these cleavages might be considered as cleavages parallel to the faces of secondary crystals of Pyroxene, but upon reflection I am fully convinced that this is not the case - for the angles which we have measured can not be deduced from the others by a strict mathematical question, and though they may approximate, they are not the same - Besides no analogy can warrant us in admitting that the regular cleavages of one substance can disappear entirely and be replaced by cleavages parallel to secondary Crystals On the Contrary wherever minerals have been found presenting different orders of cleavage, the first or those parallel to the primitive form we always predominant - Thus in Carbonate of lime it is not uncommon to meet the cleavage parallel to the rhomboidal equiaxe but I believe in every instance the primitive was predominant - In a rare and more interesting instance that of Fluor Spar Professor Mohs has described and I have seen in his possession in Freyburg specimens of the Saxon fluor which cleaved in the direction of the cube and the dodecahedron, but the Octahedral cleavage

was very distinct — Before we change our opinion on this point, we must change all our ideas of cleavage and of its high importance in the determination of minerals —

In the Hardness there is also a remarkable difference the Pyropene being decidedly harder — The ~~[illegible]~~ and ~~[illegible]~~ The specific gravity is likewise different the highest specific gravity of Pyropene recorded by Haüy is that of a large Crystal from Vesuvius which gave 3.3578 — The highest specific gravity indicated by Mohs is 3.5 while that of the Jeffersonite has in every instance which I have seen exceeded this limit —

The Chemical analysis offers another important difference, in the absence of magnesia which appears to be essential to Pyropene —

For this and other reasons I conceive that there can be no doubt as to the necessity of considering this mineral as a distinct species — I am inclined to believe that a closer study of the Leopside and Fassaite and of the Pyropene analogue might lead to a separation from the Pyropene and ~~[illegible]~~ in union with the Jeffersonite — This is a subject which appears to me fraught with interest but upon which I am not able to offer any thing but Conjectures, as my specimens of these minerals are not as good as would be necessary to enable me to decide this point — I shall merely close these remarks by observing that a similar appearance

I believe entertained by Mr Vampen—

Received of
a settlement
Wm. H. Keating
Acad
Feb. 2nd